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Effects of E. L. Thorndike's theory of connectionism rudiments on developing cello playing skills for beginners

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Abstract (A9766)

Problem Statement: Early traditions of cello playing developed in Europe in the 19th century with cellists such as Bernhard Romberg, Friedrich Dotzauer, Sebastian Lee and Carl Schröder. Numerous schools have interpreted cello education in different ways since then. However, the older cello teaching methods currently being used in many schools raise an interesting dilemma in contemporary cello education. The problem how we adapt the instructions of the 19th century traditions into the psychological and educational needs of the today's students seems very important.

Purpose of Study: The aim of this study is to observe the effects of E. L. Thorndike's educational psychology rudiments, The Theory of Connectionism, on beginner cello students to encourage their creativity and self-actualization while being instructed in traditional cello education.

Research Methods: Thirty beginner cello students from different social backgrounds between the ages of 11-15 were observed for a year during cello lessons, designed according to the essentials of Connectionism: Incremental learning, law of effect, law of exercise, multiple responses, prepotency of elements, response by analogy, identical theory of transfer, associative shifting, law of readiness, law of trial-error, and availability. Technical and musical development of the students were observed while teaching the works of Romberg, Dotzauer, Lee, and Schröder, and the relevant data was collected via recordings of these performances and cello lessons.

Findings: Essentials of the Connectionism principles play a crucial role on developing cello playing abilities such as shifting positions, hearing correct intonation-musical sentencing and making logical connections between the essentials of different cello playing techniques on the compositions studied during this research.

Conclusions: It is observed that Students have gained adequate technical efficiency to express unique musical ideas regardless of their social background and personal differences during the study.

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Key Words: Connectionism; Cello; Education

1. Introduction

1.1 *Pioneers of cello education practice in the 19. century*

Because the role of cello, in western music until the 19th century, was mostly to accompany other parts as a basso continuo both in chamber music and symphonic works, players of the time were required to compose in order to demonstrate the technical and expressive qualities of the instrument. Eminent cello player-composers from the eighteenth century, who also founded the cello teaching tradition in Europe, were Bernhard Romberg, Friedrich Dotzauer, Sebastian Lee and Carl Schröder. Their compositions included concert pieces, bow-fingering studies, and etudes. These works have lost their popularity from performing traditions, but they remained pedagogically valuable.

“The first modern virtuoso of the cello was Bernhard Romberg (1767-1841)...Born at Dinklage, Oldenburg, into a family of renowned musicians, Romberg studied with his father, who was also a professional cellist. At the age of seven, he gave his first concert...Later he became solo cellist of the Court Orchestra in Bonn...” (Markevitch, 1984, pp. 82) His talent for cello was recognized immediately by the conductor of the orchestra, Christian Neefe, who was also Beethoven’s teacher. “Neefe said of him ‘He is an extraordinary cellist who plays his own compositions with an ardent temperament.’ Of one of Romberg’s concerts, a music critic of the time had this to say: He combines in his playing an extraordinary facility with great charm. His style and expressive interpretation are perfect. He understands all the beauties of detail as well as the innate feeling of the piece. What an effect when he swells the tone to a powerful fortissimo and then follows with a diminuendo which dies out to a barely audible pianissimo.” (Markevitch, 1984, pp. 83)

Romberg was a prolific composer and a virtuoso cello player, who contributed significantly to the development of cello education practice for beginners and the formation of cello music notation. “Romberg’s contribution to the development of the cello is two-fold. First, he deserves some credit for the contemporary size and shape of the instrument. He lengthened the fingerboard and flattened it on the side underneath the C string, thus giving the string greater freedom to vibrate. According to his suggestions, the cello was also reduced in size to $\frac{1}{2}$ or $\frac{3}{4}$ in order to make it easier for children to play in the early stages of development. Second, Romberg is responsible for significant innovations regarding the application of technique to the instrument. He simplified the notation to only three clefs: treble, tenor, and bass. Until his time, multiple uses of different clefs were a common practice and a frequently occurring phenomenon...” (Raychev, 2002, pp. 22).

J.J. F. Dotzauer, a student of Romberg, was another outstanding cello player who contributed remarkably to the education and performance practice tradition of the instrument during the 19th century in Dresden, Germany. Mostly known for his pedagogic cello works, Dotzauer was a prolific composer who wrote operas, symphonies, a mass, and some chamber music. Although his compositions written for cello are often not performed by contemporary players, the educational value of his works remains important. Dotzauer’s numerous cello methods include technical studies, daily exercises and etudes that are effective for developing both simple and advanced cello playing skills. “Since their appearance, the Violoncello Etudes by Dotzauer-who was born June 26, 1783, and died March 6, 1860 have ranked high among works of their class and, by reason of their intrinsic practical utility, have successfully maintained their position...Dotzauer’s numerous etudes are an outgrowth of mature experience in teaching, and display such a full and comprehensive understanding of the peculiarities of the instrument, that their well-earned place in the literature of violoncello-instruction would seem to be assured for the future also.” (Klingenberg, pp.1)

Studying with J. N. Prell, another student of Romberg, Sebastian Lee was a cello player and a teacher from the tradition of Romberg. Despite being one of the most prominent cello virtuosos of his time, Lee is known for his pedagogic works for cello like most of his 19th century colleagues. “Sebastian Lee was the eldest and most brilliant and distinguished of three musical brothers, natives of Hamburg...Like his brother Louis, he devoted himself to the cello and became one of the most prominent of the solo performers upon that instrument... Like most other virtuosos, Lee published many pieces designed to exploit a virtuoso’s powers upon his instrument-variations, fantasies upon operatic themes, divertissements, etc. More important are his numerous compositions intended for purposes of instruction...” (Shulz, 1931, pp. 1).

Another important cellist from the 19th century is Carl Schröder. His significant contribution to cello teaching tradition is evident within his books on technical studies mostly covering fingering and bowing exercises for beginners. Besides his recommendations for developing basic cello playing skills for beginners, he edited some of

Romberg's and Dotzauer's works such as Op.48 and Op.78 cello concertos by Romberg and *Variations on a Theme from Norma*, Op.135 by Dotzauer.

1.2 Thorndike & connectionism rudiments

Edward Lee Thorndike (1874-1949), American psychologist, educator, and lexicographer, was a pioneer in the adult education movement and was one of the first to develop intelligence tests that distinguished between the ability to learn and already acquired knowledge. Associated with Teachers College, Columbia University during most of his professional career, Thorndike got his undergraduate and graduate degrees from Wesleyan and Harvard Universities. His theories about the learning process in humans contributed to the educational psychology practice significantly in the 20th century. Thorndike is best known for his *Theory of Connectionism*.

“Connectionist models exhibit parallel distributed processing (PDP). In contrast to symbolic models, which represent one idea per node, they represent concepts as patterns of activation distributed across many nodes and links. Nodes respond to input in parallel and in turn excite or inhibit the other nodes they connect to. Connectionist models learn by matching the output they generate to the correct output they are shown during training. Mismatch between the two results in an error signal that is fed back into the system, which adjust the strength of the links between nodes so the match is improved next time around.” (Andrade, May, 2004, pp.99)

With his theory of *Connectionism*, Thorndike claims the learning process is completed only when the subject makes accurate connections between the new information. Rudiments of *Connectionism* used in this research to develop cello education methodology for beginners are incremental learning, law of effect, law of exercise, multiple responses, prepotency of elements, response by analogy, identical theory of transfer, associative shifting, law of readiness, law of trial-error, and availability.

Incremental learning essential claims students can gain the expected ability only with successive introduction of the elements of the topic, starting from the simplest one. The law of effect advocates making logical connections between the aims and the expectations because new materials can be internalized only when they lead to success. According to the law of exercise, the relationship between the stimuli and the responses strengthens with repetition. Multiple responses rudiment is established on the presentation of an already acquired behaviour. To this end, students are expected to gain the ability to change responses depending on various stimuli under different circumstances. Prepotency of elements essential aims to use the most striking feature of information during the teaching process making the new data more attractive and therefore, easier to internalize. Response by analogy rudiment employs the possible use of already acquired knowledge in case of corresponding states. The more similar the information is presented the more analogous stimuli are shown by the students according to the identical theory of transfer rudiment. Associative shifting includes the use of both responses by analogy and identical theory of transfer. Accordingly, students are expected to develop the ability of using already acquired knowledge in completely different situations. Law of readiness emphasizes that students should have appropriately enough background information before they are introduced to new data. The process of trial and error intends students to gain the ability of ignoring non-beneficial data from beneficial data. In conclusion, availability rudiment of *Connectionism* claims that students can gain the ease of using knowledge permanently in many different occasions after the learning stages are completed, and the accurate connections are made between the relevant data.

2. The Theory of Connectionism on Teaching the Works of Romberg, Dotzauer, Lee and Schröder

2.1 Incremental learning

According to Thorndike, internalization process of new information does not occur abruptly. It happens with the succeeding stages of activities. The rudiment was employed during the training period of etude no. 17 from *Exercises for the Violoncello Op. 113* by Dotzauer. (See example-1) The etude requires students to be able to organize the bow and the left hand efficiently enough on all four strings of the cello while shifting positions. Because learning is incremental, the prerequisites of this subject is to practice basic bowing-fingering exercises and shifting positions between the notes of the etude so that useful connections between stimuli, the ability of using both hands simultaneously, and response, the ability of performing the piece, can be made. To this end, the students

studied etudes from the cello methods of Sebastian Lee and Carl Schröder and the parts of the Dotzauer etude no. 17 separately. (See example 2-3-4).



Example 1: F. Dotzauer, *Exercises for the Violoncello Op. 113*, Etude No. 17



Example 2: Carl Schröder, *Practical Method for the Violoncello*, Etude No. 6



Example 3: Carl Schröder, *Practical Method for the Violoncello*, Etude No. 17



Example 4: Carl Schröder, Bowing and Fingering Exercises



4a. Sebastian Lee, *First Steps in Violoncello Playing Op 101*, Exercise for the Left Hand

2.2 Law of effect

Connections between stimuli and responses strengthening or weakening largely depends on how accomplished the students become at the end of the teaching process. In other words, the more the given information leads to success, the better the information is internalized and used effectively. Observing outcomes of a teaching period on cello education is mostly done on two occasions: exams and stage performances. To this end, Schröder Op. 31 Etudes were played on cello juries; Lee Op. 31 and Dotzauer Op. 113 Etudes, Romberg Op. 38 and 43 Cello Sonatas were played during stage performances.

2.3 Law of exercise

Students tend to remember recurring data and they tend to forget nonrecurring data. Employing law of exercise essential on cello education is established on the presentation of similar instrument playing techniques on different compositions. Schröder Op. 31 Etudes were used to teach triplets rhythmic structure in order to help students practice rhythmically similar segments of Romberg Op. 43 and 38 Sonatas. (See example-5)



Example 5: Carl Schröder, *Die ersten Violoncello-Übungen*, Op.31, Etude No. 11



5a. Romberg Sonata in e minor Op. 38 No. 1



5b. Romberg Sonata in B Flat Major Op. 43 No. 1

2.4 Multiple responses

Use of multiple responses essential on cello education aims for students to develop the ability of responding to multiple stimuli on a composition that features diverse instrument playing techniques. Staccato bow structure was taught to help students develop their ability to generate multiple responses to multiple stimuli. To this end, an etude from Schröder's Op. 31 Cello Method was used to teach a melody associated with staccato bow structure. (See example 6)



Example 6: Carl Schröder, *Die ersten Violoncello-Übungen*, Op.31, Etude No. 19

2.5 Prepotency of elements

Employing prepotency of elements essential recommends determining the most noticeable components of a composition and instructing these elements as the initial steps of a training period. Effectiveness of this essential is observed by teaching Romberg Sonatas because they are among the first examples of melodically appealing pieces for beginners. Before practicing the sonatas, students were introduced to Lee Etudes, designed to practice vibration to help them play the melodic lines of the sonatas more effectively. After the stage and jury performances of the etudes, training period continued with Romberg Sonatas. In this case, proponent element of the works is their melodic structure. (See example 7)



Example 7: Entrance cello theme from Romberg Cello Sonata in E Minor



7a. Entrance cello theme from Romberg Cello Sonata in B flat Major

2.6 Response by analogy-identical theory of transfer-associative shifting

Use of response by analogy for teaching cello employs the idea of the possibility of displaying similar responses increases to similar stimuli. Likewise, identical theory of transfer essential indicates the more similar the playing abilities involved on a composition to be taught, then the better the students will make connections among the related data. Associative shifting, comprising the two rudiments, studies the affective use of both responses by analogy and identical theory of transfer. Compositions taught by using the essentials are Romberg Op. 43-38 Sonatas and etudes from Schröder's Op. 31 Cello Method.

The first stage of the preparation period employed scales that were structured according to the technical features of the pieces to be taught to attain analogical responses. D, G, A, C, E flat, and B flat major scales were taught in two, four, eight, and sixteenth note combinations with both legato and staccato bowings on one, two and four note slurs. The study aimed to have students make evocative connections between the technical features of the scales and the compositions.

Employing the identical theory of transfer essential, students were taught Romberg Op. 43 and Op. 38 Sonatas consecutively due to their technical and musical resemblances. The pieces were used to help students develop the ability to transfer similar playing abilities and musical structures between the compositions. At the end of the teaching period, the newly gained cello playing abilities were shifted to more complex compositions without practicing the sonatas and the scales. The students could now accomplish associative shifting.

2.7 Law of readiness-law of trial-error-availability

The most important aspect of using the law of readiness essential on cello instruction is determining the length of the training period. Performances of compositions, discussed during cello lessons, determine whether the students develop respectable skills and are ready to play the works or need further training. The development of an important skill after the previous stage is the ability to select and employ beneficial data and connecting it to the topic by utilizing the trial-error rudiment. Gaining the requirements of the trial-error essential allows students to solve the nodes instantly.

After the teaching plan is complete, students are expected to easily make precise connections between the elements of the topic, which leads to the permanent internalization of the information and self-actualization. Employing the three essentials involves stage and jury performances of Romberg Sonatas, etudes from Schröder, Dotzauer, and Lee's cello methods.

3. Conclusion

Employing Thorndike's Theory of Connectionism essentials, this study aimed to teach the fundamentals of cello playing to beginners. Materials for the training period were selected from the works of Dotzauer, Lee, Schröder, and Romberg. The initiation point of the teaching plan was established on Schröder, Lee, and Dotzauer etudes with the use of incremental learning essential. These works include the essential basics of cello playing such as bowing-fingering exercises and shifting positions. Because learning is incremental, students were first trained to coordinate the bow and the left hand with the Etudes of Schröder and Lee. Secondly, they were taught to shift positions with Dotzauer Etudes. The use of law of exercise and multiple responses essentials employed Schröder etudes and Romberg Sonatas. Schröder etudes were used to have students develop the ability of playing staccato bow structure as hearing melody with correct intonation and compare the triplet rhythmic structure of the etude with Romberg Sonatas. In the end, students accomplished the requirements of the three essentials and were able to play the works successfully.

The two most important activities involving the law of effect essential in this study were stage performances and cello juries. During the preparation period, stage performances of even the simplest works for beginner cello students strengthened the connections between the stimuli and the object. This was a key observation. As the students became more and more accomplished after the training period, the additional information was more efficiently internalized.

Romberg Sonatas are among the first examples applying cello as a solo instrument in a sonata form. The works' appealing melodic line was drawn on to employ the prepotency of elements essential. Employing responses by analogy, identical theory of transfer, and associative shifting essentials required the combined employment of the etudes and the sonatas during the training period.

Successive accomplishment of the requirements of law of readiness, law of trial-error, and availability essentials determined the last stages of the study. It was concluded that the students, responding the previous studies, were able to make connections between the related data and performed the compositions successfully regardless of their social backgrounds.

In conclusion, the application of incremental learning and multiple responses rudiments were beneficial for teaching the technical demands of cello playing. Response by analogy, identical theory of transfer, and associative shifting essentials were useful in combination to teach both the technical and the musical requirements of the compositions. Law of readiness, law of trial-error, and availability were the last stages of instruction that focused on the interpretation complexity of the works.

4. References

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